


TARDEC Program Reviews VTC for RDECOM S&T Advisors

How CRES-GV will change Ground Vehicle Performance Analysis

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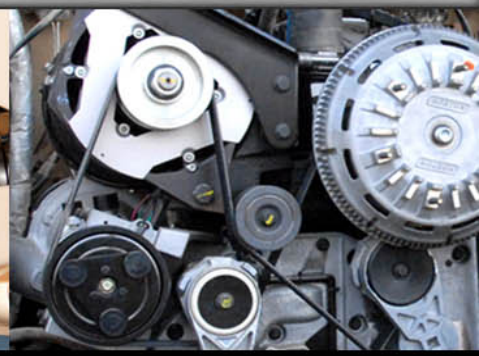
Alan Hufnagel



Problem Statement

Problem:

Ground vehicle development projects make high impact design and requirement decisions with limited knowledge

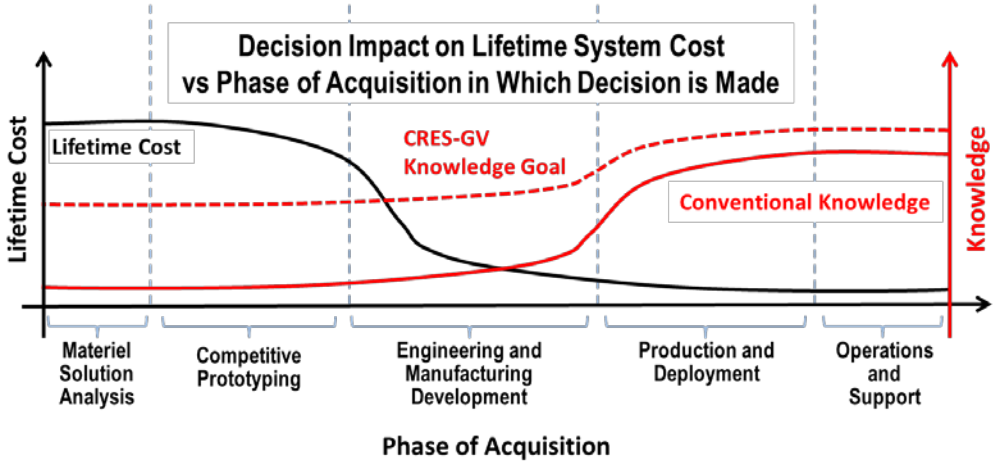
Why:

Have very limited knowledge, especially in the early stages of a program

Example:

Towing Requirement

- Vehicle Mass?
- Engine Size?
- Radiator Size?
- Tire dimension?



Current Performance Analysis

- Experience
  - Extrapolate past project experience into future
  - Rule of Thumb
- Testing
  - Slow & expensive
  - Need to have a prototype system
- Low Fidelity Modeling
  - Current trade space tools use low fidelity models
    - Typically no physics or system interactions
    - Based on subject matter expert opinion
    - Can require custom programming of trade space tools
      - Slow & expensive
- Limited High Fidelity Modeling
  - Single physics models
    - System interactions not modeled
  - Require time and expert analyst
    - Often not done due to resource constraints

CRES-GV Performance Analysis

- Multiphysics performance analysis
  - Co-simulation of critical systems to capture interactions
  - Example: Vehicle Dynamics, Vehicle Powertrain, Vehicle Cooling, Terrain
  - Requires High Performance Computer Cluster (HPC)
- Analysis of entire vehicle trade space
  - Use High Performance Computing clusters (HPC) to examine 1000's of vehicle permutations
  - Span entire design space
- Streamlined, web-enabled process
  - Connection to Trade Space Tools
  - Database of validated results
  - Streamlined & simplified interface for normal users
    - PM & PEO offices, contractors
  - Interface for advanced users
    - Government Power Users
- Collaboration between TARDEC, ERDC, HPCMP

TARDEC

U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER ERDC

DOD HPC MODERNIZATION PROGRAM

CRES-GV Priorities per GV PEOs

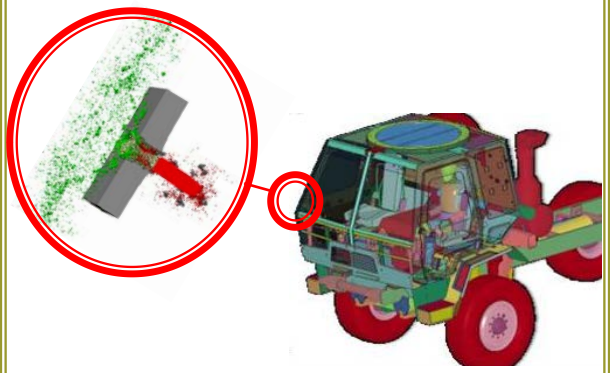
End-To-End Mobility Solver

Off Road Mobility M&S

- Detailed Track/Tire – Soil Model
- Detailed Vehicle Dynamics
- Powertrain M&S Integration

#1

Systems Level Ballistic Penetration

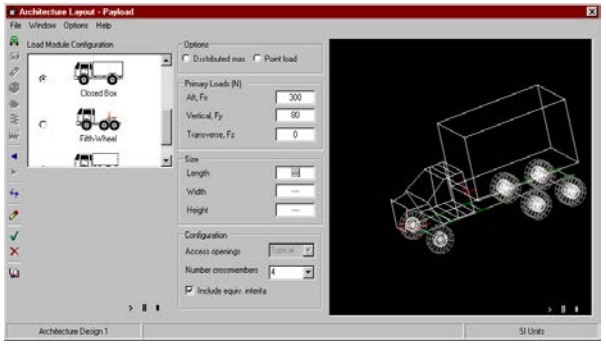


- System level armor model
- Weld, joint effects
- Attachment modeling
- Virtual live-fire test

#3

USMC FACT & GCS WSTAT:

Provide Rapid Physics-Based Data to Systems Tradespace Tools



- Dynamics & Mobility
- Power-train
- Survivability
- Thermal & Signatures
- Antenna & Sensor placement
- Ergonomics
- Cost implications

#2

CRES-GV Mobility Product Architecture

CRES-GV Community

CCE Web Server

Web GUI

Forms

Charts

3D Visualization

GVI

Web Services

HPC

HPC UIT

End-To-End Mobility (E2EM)

Vehicle Dynamics

Vehicle Control

Human Response

Sensors

Powertrain & Cooling

Fording & Swimming

Vehicle-Terrain Interface

Performance Analysis Tools

Mobility Analysis Tool (MAT)

Visualization Processing

CCE DB Server

Simulation Parameters
(e.g. vehicle definition)

Bulk Storage
(e.g. terrain)

Tradespace Tool Adapter

HPC Direct Access
(Power User Alternative)

CCE Web Server

Environmental Simulator

External

ERS

FACT

WSTAT

End-To-End Mobility Solver
Goal: Physics based approach to evaluate off-road mobility

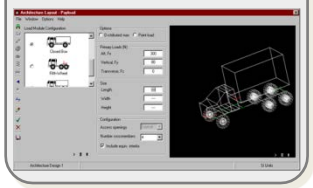
CRES-GV Products

- End-To-End Mobility (E2EM)
  - Physics based tool for mobility with multi-physics simulation of terrain mechanics and vehicle systems and components (e.g., suspension, running gear, and powertrain)
- Systems Level Armor Protection (SysLAP)
  - Physics based tool for modeling integrated armor systems for vehicle platform survivability against blast, impact, and penetration
- Performance Analysis Tools
  - Tool suite for analyzing HPC physics data from E2EM and SysLAP; enable trade space exploration and systems engineering
- Ground Vehicle Interface (GVI)
  - User interface for intuitive access to the analysis capabilities of the CRES-GV tools by SME power users and tradespace analysts

End-To-End Mobility Solver
Goal: Physics based approach to evaluate off-road mobility

Systems Level Ballistic Penetration Solver
Goal: Physics based evaluation of armor "as-integrated" on a platform

USMC FACT & GCS WSTAT: Provide Rapid Physics-Based Data to Whole Systems Tradespace Tools
Goal: Physics based approach to assess design concept tradespace



CRES-GV Takeaways

- Many program decisions are made with limited knowledge today
- CRES-GV will positively impact vehicle performance analysis
  - HPC enabled, physics based, trade space analysis
  - Focus on providing physics based models early in program life-cycle
  - Co-simulation to model system interactions
  - Streamlined, web-enabled process
- Software releases in FY15-17
- Collaboration between TARDEC,ERDC, HPCMP
- Payoff
  - Early design flaw detection
  - Reduced development time
  - Better mission-suitable designs
  - Lower life cycle costs